CS171 Recitation 2

Wireframe Renderer

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Renderer Overview

- OpenInventor Parser
- Point Transformation and Projection
- Line Rasterizer


OpenInventor Language

```
PerspectiveCamera {   # Sets up Camera location, field of view, etc.
      position      0 0 1
      orientation   0 0 1  0
      nearDistance  1
      farDistance   10
      left          -1
      right          1
      top            1
      bottom        -1
   }
   Separator {
      Transform {
         translation  tx ty tz  # 3 real numbers
         rotation     axisX axisY axisZ angle
         scaleFactor  sx sy sz  # 3 real numbers
      } # end of Transform

      # Creates list of 3D pts, named with integers starting at 0
      Coordinate3 {
         point [
            x0 y0 z0,
               ...
            xn yn zn
         ]
      }

      # Uses the integer names of the pts to make polygonal faces
      IndexedFaceSet  {
         coordIndex [
                  face0point0, face0point1, ... -1,
                  face1point0, face1point1, ... -1,
                     ...
                  faceNpoint0, faceNpoint1, ... -1
    ]
   }
}
```


Camera Block

- One camera for the entire scene:

```
PerspectiveCamera {
        position        0 0 1
        orientation     0 0 1  0
        nearDistance    1
        farDistance     10
        left            -1
        right           1
        top             1
        bottom          -1
    }
```


Separator Block

- Organizes all geometry undergoing the same transformation

```
separator {
    Transform { }
    Coordinate3 { }
    IndexedFaceSet {}
}
```


Transform Block(s)

```
Transform {
        translation   tx ty tz
        rotation      axisX axisY axisZ angle
        scaleFactor   sx sy sz
}
...
```


Coordinate3

```
Coordinate3 {
        point [
                x0 y0 z0,
                ...
                xn yn zn
        ]
}
```

IndexedFaceSet

```
IndexedFaceSet  {

        coordIndex [
                face0point0, face0point1, ... -1,
                face1point0, face1point1, ... -1,
                   ...
                faceNpoint0, faceNpoint1, ... -1
        ]
}
```

Transformations

Object ==> World ==> Camera ==> NDC


Transformations

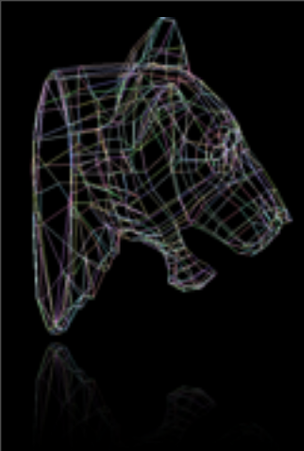
Object ==> World

- Construct matrix for each transform block
  - $Transform_i = T_iR_iS_i$
    - Remember: T, R, S can appear in any order (or not at all!)
- Combine all of the separator's transforms:
  - $O = Transform_0 * Transform_1 * ...$
  - (First transform is applied last)


Transformations

World ==> Camera

- Use position and orientation from the PerspectiveCamera block to construct Camera ==> World matrix, TR
- Camera transform is the inverse:
  - $C = (TR)^{-1} = R^{-1}T^{-1}$
- Use formulas for inverted translation/ rotation instead of inverting the matrix.




Transformations

Camera ==> NDC

- All coordinates in [-1, 1]
- Perspective projection using parameters from the PerspectiveCamera block
- After projection and homogenization, (x, y) coordinates are used to draw lines.
- z is used in HW3 as a depth value
- Formula and derivation are linked from the HW page


Your Program

- wireframe xres yres
- (xres, yres are output image resolution)
- Read OpenIV file from stdin
- Write PPM image to stdout
- Test against the provided examples


Plan

- Define an AST for the OpenInventor Language
  - (mostly complete) BNF given on the HW page
- Write your parser (translate grammar into Bison syntax)
- Add code to apply parsed transformation to points and draw using your HW1 rasterization code

Left/Right Recursion

Use Left Recursion!

```
singles:
    NUMBER
    {
        $$ = new list<double>;
        $$->push_back($1);
    }
|
singles COMMA NUMBER
{
    $1->push_back($3);

    $$ = $1;
}
;
```

Instead of

```
singles:
    NUMBER
    {
        $$ = new list<double>;
        $$->push_back($1);
    }
|
NUMBER  COMMA singles
{
    $3->push_front($1);

    $$ = $3;
}
;
```